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Correlates of medication error in hospitals

by Kathryn Wilkins and Margot Shields



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Abstract

Objectives

This article examines associations between medication error and selected factors in the workplace of hospital-employed registered nurses (RNs) in Canada.

Data sources and methods

Data are from the 2005 National Survey of the Work and Health of Nurses, and were weighted to be representative of all RNs in Canada who deliver direct care to hospital patients. Correlates of medication error were considered in bivariate and multivariate analyses. Multiple logistic regression modeling was used to examine medication error in relation to work organization and workplace environment, while controlling for personal factors, including nurses' general and mental health, job dissatisfaction, education, years of experience in nursing, and clinical area of employment.

Results

Nearly one-fifth (19%) of hospital RNs reported that medication error involving patients in their care had occurred "occasionally" or "frequently" in the past year. In the fully adjusted multivariate model, medication error was positively associated with usually working overtime, role overload, perceived staffing or resource inadequacy, low co-worker support, and low job security. Usually working a 12-hour shift, compared with shorter shifts, was negatively associated with medication error.

Keywords

Drug administration, hospitals, nursing care, resource allocation, workload, workplace

Authors

Kathryn Wilkins (Kathryn.Wilkins@statcan.ca; 613-951-1769) and Margot Shields (Margot.Shields@statcan.ca; 613-951-4177) are with the Health Information and Research Division at Statistics Canada in Ottawa, Ontario, K1A 0T6.

Accumulating evidence from Canada and elsewhere indicates that, during their hospital stay, an appreciable number of patients experience adverse events, such as medication error, injurious falls, nosocomial infection, and other "medical misadventures."^{1,2} A recent Canadian study reported that medication- or fluid-related error was second only to surgical error as the most common type of such incidents.¹

Most studies of medication error have been based on data gathered from clinical records, which are well known to yield incomplete information. Partly because of fear of reprisal, very few incidents—probably only the 5% or so that are considered potentially life-threatening—are noted in patients' charts.³⁻⁶ Therefore, from a review of clinical records, it is not possible to assess the true frequency of medication error, nor to identify the circumstances that contribute to such error.

Nurses, who typically administer medications to patients in clinical settings, are the usual focus of investigations of medication error. In fact, a key feature of nurses' training is that any failure to administer the "right drug in the right dose at the right time to the right patient by the right route" is the nurse's responsibility, even if it results from compliance with an inappropriate order written by a physician, a pharmacist's dispensing error, or a patient's inability to swallow. The expectation is that the nurse will clarify ambiguous orders; have the requisite knowledge and strength of character to question orders that are inappropriate; double- and triple-check the medication, dosage and identity of the patient; administer the medication at the right time and through the correct route; and closely monitor the patient.

Increasingly, however, the literature reflects a shift in focus away from the individual nurse as the "cause" of medication error to a consideration of the broader context. There is growing awareness that a complex interplay of circumstances in the clinical environment, rather than simply an individual's carelessness, contributes to the risk of error.^{2,7-10}

Although the results are mixed, several studies suggest that links exist between medication error and systemic organizational factors. These include nurse staffing adequacy, hours worked per week, overtime, staffing mix (professional versus unregulated), and other factors reflecting how the work system is designed.^{5,11-13}

Evidence of links between stress in the clinical workplace and medication error is also emerging. For example, a recent study of nurses in Alberta and Ontario found that patient safety outcomes—including medication error and other adverse events—were associated with emotional exhaustion ("burnout") in nurses, which in turn was related to staffing inadequacy, poor nurse-physician relations, and other "worklife" factors.¹⁴

When their confidentiality is protected, nurses can be an excellent source of information about the occurrence of and the conditions that give rise to medication errors. For instance, an American study that asked nurses to keep anonymous logbooks over

a 23-day period found that 30% of them recorded at least one medication error. Nurses mentioned heavy workloads, complexity of the patients' needs, interruptions, and poor communication among health care providers as reasons for the errors.^{15,16}

The 2005 National Survey of the Work and Health of Nurses (NSWHN) is a rich source of information reported anonymously by nurses across Canada. NSWHN data were collected by telephone under the strict protection of respondent confidentiality. These data offer an opportunity to study nurses' perceptions of patient safety—in this case, the frequency of medication error—in relation to factors reflecting the way in which their work is organized, as well as to those reflecting the interpersonal environment.

The objective of this study is to examine associations between medication error and work organization and workplace environment, while controlling for the possible influence of personal and health-related characteristics. The theoretical perspective was guided by the literature on determinants of nursing care outcomes in general, and adverse events in particular.^{6,14,17-23} The conceptual model was based on a modified version of Donabedian's structure-process-outcome framework.¹⁷

The selection of variables for this analysis was influenced by their availability in the NSWHN. "Structure" was represented by variables concerning work organization: usually working overtime (paid or unpaid), a shift other than days, 12-hour shifts, more than 40 hours per week (at all jobs combined), having a part-time job, and clinical area of usual employment. "Process" was represented by variables having to do with the workplace environment, including nurse-physician working relations, perceived workload, perceived adequacy of staffing and resources, and work stress. Work stress factors were low co-worker support, low supervisor support, low job security, and high physical demands. "Outcome" was nurse-reported medication error. Personal characteristics that were controlled for in multivariate analysis were level of nursing education, years of experience as a nurse, job dissatisfaction, and general and mental health.

Methods

Data source

The data for this study are from the National Survey of the Work and Health of Nurses (NSWHN), a comprehensive survey of employed, regulated Canadian nurses (registered nurses, licensed practical nurses, and registered psychiatric nurses) conducted by Statistics Canada in partnership with the Canadian Institute for Health Information and Health Canada.²⁴ The purpose was to collect information from nurses in all provinces and territories about their work environment, workload, perceived quality of patient care, and their physical and mental health. The content of the survey was determined under the guidance of an expert advisory committee, with the intention of providing data for analysis focusing on links between the nursing practice environment and various nurse and patient outcomes.

The NSWHN sample was selected at random from membership lists provided to Statistics Canada by all 26 provincial and territorial nursing organizations and regulating bodies across Canada. Data collection took place from October 2005 to January 2006. The survey was administered by telephone; a typical interview lasted 30 minutes.

Of the 24,443 nurses initially selected for the sample, 21,307 were successfully contacted, and of these, 1,015 were out-of-scope—meaning that they were not employed in nursing at the time of the survey. Another 1,616 (7.6% of the 21,307 who were contacted) refused to participate. Complete responses were obtained from 18,676 nurses, for a response rate of 79.8%. Of these, 4,379 were registered nurses providing direct care to hospital patients; the analysis was based on weighted data from these respondents.

Definitions

The NSWHN collected information on the occurrence and frequency of *medication error* using the question: “The next questions are about possible incidents involving you or the patients you directly care for. In the past 12 months, how often would you say: A patient received the wrong medication or dose? never? / rarely? / occasionally? / frequently?” Responses were grouped into two

categories: never or rarely, and occasionally or frequently.

Type of care provided was ascertained by asking, “Do you work in direct or non-direct patient care?” According to their responses, nurses were categorized as providing direct or indirect care; those who provided both were categorized as providing direct care.

For nurses with more than one nursing job, the “main job” was defined as the one at which the most hours were usually worked per week at the time of the interview. However, for respondents selected from the registration lists of Yukon Territory, Northwest Territories and Nunavut, the main job was defined as their job in the North, even if they had a second job outside the North at which they worked more hours during the year. (Of the estimated 1,400 nurses identified as employed in a Northern territory, 30% provided only short-term relief work there.)

Full-time status of the main job was established by asking respondents if they worked full- or part-time.

Usual shift for the main job was determined with the question, “Do you usually work days, evenings or nights?” Four response categories (days, evenings, nights and mixed shifts) were available to interviewers, but they read only the first three to respondents.

To determine length of shift, nurses were asked, “Do you usually work . . . an 8-hour shift, a 12-hour shift, some other shift . . . or various shifts?” Those who responded “some other shift,” were asked to specify the number of hours they usually worked per shift. Nurses were classified as working a *12-hour shift* if their response to the first question was a 12-hour shift, or if their response to the subsequent question indicated that their usual shift was more than 12 hours.

Overtime (time worked beyond what is scheduled) at the main job was determined with the questions, “How many hours of paid overtime do you usually work per week?” and “How many hours of unpaid overtime do you usually work per week?” Respondents who usually worked any number of hours of paid and/or unpaid overtime were defined as usually working overtime.

Number of jobs at the time of the survey was determined by asking about nursing jobs other than the main job, as well as jobs or businesses outside nursing.

Total hours worked at all jobs combined was derived by summing the total hours worked at the main job and the total hours at all other jobs.

Role overload (quantitative) is an index designed to measure the perceived appropriateness of the amount of work to be done in the time available; its reliability has been shown in previous assessments to be moderate (0.56),^{25,26} although the Cronbach's alpha for this scale in Canadian nurses was 0.79.²⁴ Respondents were asked to rate their level of agreement on a five-point scale (strongly agree – score 4, agree – score 3, neither agree nor disagree – score 2, disagree – score 1, strongly disagree – score 0) with five statements:

- “I often have to arrive early or stay late to get my work done.”
- “I often have to work through my breaks to complete my assigned workload.”
- “It often seems like I have too much work for one person to do.”
- “I am given enough time to do what is expected of me in my job.” (Reverse scored.)
- “I have too much to do, to do everything well.”

A total role overload score (with a possible range of 0 to 20) was calculated by summing the scores for the five items, with higher scores indicating more role overload. Cut-points were determined to divide the weighted distribution of scores into quartiles: first quartile – less than 9; second quartile – 9 to 12; third quartile – 13 to 15; fourth quartile – over 15. Of the total 4,379 nurses in the sample used for this analysis, 31 had missing information for role overload. A dummy variable for missing role overload was created in order to maximize the number of records that were included in multivariate analysis.

The Nursing Work Index (NWI) is a set of measures developed to study the nursing practice environment.²⁷ Two subscales of the NWI were used for this study: Staffing and Resource Adequacy and Nurse-Physician Working Relations. Satisfactory reliability and validity statistics for these subscales

have been reported.^{24,28,29} Response options were based on a four-point Likert-type scale: strongly agree – score 0, somewhat agree – score 1, somewhat disagree – score 2, strongly disagree – score 3.

The following statements comprise the *Staffing and Resource Adequacy* Subscale:

- “Adequate support services allow me to spend time with my patients.”
- “There is enough time and opportunity to discuss patient care.”
- “There are enough nurses on staff to provide quality patient care.”
- “There is enough staff to get the work done.”

A total score (with a possible range of 0 to 12) was calculated by summing the scores for the four items, with higher scores indicating greater perceived inadequacy. To maximize the number of respondents, one “not applicable” or “not stated” response was accepted. A score was calculated based on the items with responses and then adjusted to compensate for the item without a response.²⁴ Cut-points were determined to divide the weighted distribution of scores into quartiles: first quartile – 0 to 3; second quartile – 4 to 5; third quartile – 6 to 8; fourth quartile – 9 to 12.

Three statements were used to measure *nurse-physician working relations*:

- “Physicians and nurses have good working relations.”
- “There is a lot of team work between nurses and physicians.”
- “There is collaboration between nurses and physicians.”

A total nurse-physician working relations score (with a possible range of 0 to 9) was calculated by summing the scores for the three items, with higher scores indicating worse relations. To maximize the number of respondents for whom scores were calculated, one “not applicable” or “not stated” response was accepted. A score was calculated based on the items with responses and then adjusted to compensate for the item without a response.²⁴ The weighted distribution of the scores was divided into quartiles: first quartile – 0; second quartile – 1 to 2; third quartile – 3; fourth quartile – 4 to 9.

Two statements were used to measure *co-worker support*:

- “You were exposed to hostility or conflict from the people you work with.”
- “The people you work with were helpful in getting the job done.”

Response options were: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree. Respondents were classified as having low co-worker support if they indicated “strongly agree” or “agree” in response to the first item, or “disagree” or “strongly disagree” in response to the second.

Supervisor support was measured with the item, “Your supervisor is helpful in getting the job done.” Respondents were classified as having low supervisor support if they indicated “disagree” or “strongly disagree.”

Job security was measured with the item, “Your job security was good.” Respondents were classified as having low job security if they indicated “disagree” or “strongly disagree.”

Physical demands of the job were measured with the item, “Your job required a lot of physical effort.” Respondents were classified as having high physical demands if they indicated “agree” or “strongly agree.”

Number of *years in nursing* was dichotomized as five or fewer, and more than five.

Levels of *general health* and *mental health* were assessed by asking, “In general, would you say your health is: excellent? / very good? / good? / fair? / poor?” and “In general, would you say your mental health is: excellent? / very good? / good? / fair? / poor?” Responses were categorized into two groups: excellent, very good or good; and fair or poor.

Job dissatisfaction was assessed by asking, “On the whole, how satisfied are you with this job . . . very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied?” Respondents who indicated that they were “somewhat” or “very” dissatisfied were classified as being dissatisfied with their job.

Analytical techniques

The NSWHN data were weighted to be representative of all regulated nurses across Canada. For this analysis, weighted data for hospital-employed Registered Nurses whose work involved

providing direct care were used. Frequency estimates were produced to examine characteristics of the study population, and bivariate estimates were used to examine the likelihood of occasional or frequent medication error in relation to selected variables. Logistic regression modeling was used to study medication error in relation to work organization and workplace environment, while controlling for personal characteristics and clinical setting of employment. The selection of independent variables for inclusion in the model was guided by the literature and examination of bivariate relationships. To account for survey design effects, the bootstrap technique was used to estimate variance on estimates, on differences between proportions, and confidence intervals around odds ratios.³⁰⁻³²

Results

Personal characteristics

In 2005, registered nurses (RNs) delivering direct patient care in hospitals numbered 143,000 (Table 1).

Table 1
Selected characteristics of registered nurses providing direct care to hospital patients, Canada, 2005

	Estimated number	%
Total	143,000	100
Sex, education, experience, job satisfaction		
Female	134,900	94.3
Male	8,100	5.7
Average number of years worked as a nurse (SD)	17.0(10.6)	...
Bachelor's degree in nursing or higher	37,600	26.4
Dissatisfied with job	18,500	12.9
Health		
Fair or poor general health	9,300	6.5
Fair or poor mental health	8,100	5.7
Work organization		
Full-time job	87,000	61.1
Usually works day shift	45,600	31.9
Usually works 12-hour shift	60,900	42.5
Usually works overtime (main job)	96,500	67.4
Has more than one job	24,800	17.3
Usually works 40 or more hours per week (all jobs combined)	53,000	37.1
Work stress		
Low co-worker support	65,800	46.0
Low supervisor support	40,600	28.4
Low job security	9,100	6.4
Physically demanding job	110,200	77.0

... not applicable

Source: 2005 National Survey of the Work and Health of Nurses.

They averaged 17 years of employment as a nurse. Just over one-quarter (26%) had a baccalaureate degree (or higher) in nursing. Only 6% were men.

Hospital RNs were in good health. Only around 6% reported their general health to be “fair” or “poor,” and a similarly low proportion reported their mental health to be in these categories.

Work organization

Nearly one-quarter (23%) of hospital RNs worked in medical or surgical wards (data not shown). About 13% were in maternity or newborn care units; 11% in the Emergency Room, and another 11% in the operating theatre or recovery room. Just under one in ten was in a critical care unit, and 7% reported working in several clinical areas. One in 20 worked in a psychiatric unit, and nearly the same proportion worked in ambulatory (outpatient) care. The remainder were distributed in lower proportions among oncology, geriatrics, pediatrics, rehabilitation, and palliative care.

The majority (61%) of hospital RNs had a full-time job. Reflecting the around-the-clock demands of delivering patient care, more than two-thirds usually worked hours other than the day shift (evenings, nights or mixed shifts). Twelve-hour shifts were common—reported by 45%. Over two-thirds of hospital nurses usually worked overtime (paid or unpaid) at their main job, and well over one-third (38%) reported more than 40 hours per week at all jobs combined.

Workplace environment

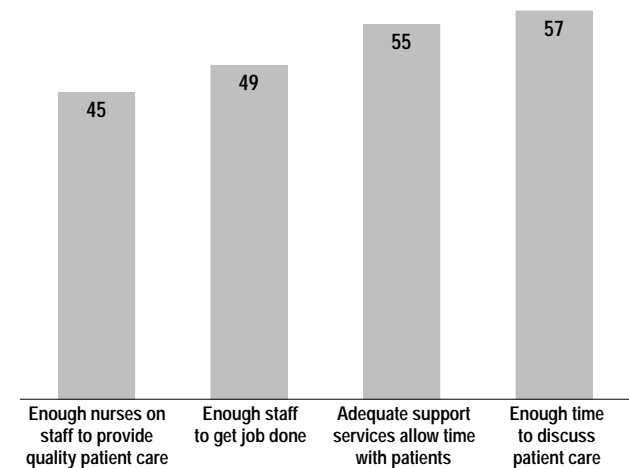
Although the *Staffing and Resource Adequacy Subscale* is based on the total score of all four of its elements, response frequencies to the individual items are more informative. Less than half of hospital RNs agreed with the statements, “There are enough nurses on staff to provide quality patient care,” and “There is enough staff to get the work done” (Figure 1). Just over half reported that support services and time to discuss patient care were adequate.

In strikingly large proportions, hospital RNs reported favourable working relations with physicians. Fully 89% agreed with the statement, “There is collaboration between nurses and

physicians” (data not shown). Nearly as many (87%) agreed that “Physicians and nurses have good working relations,” and 82% agreed that “There is a lot of team work between nurses and physicians.”

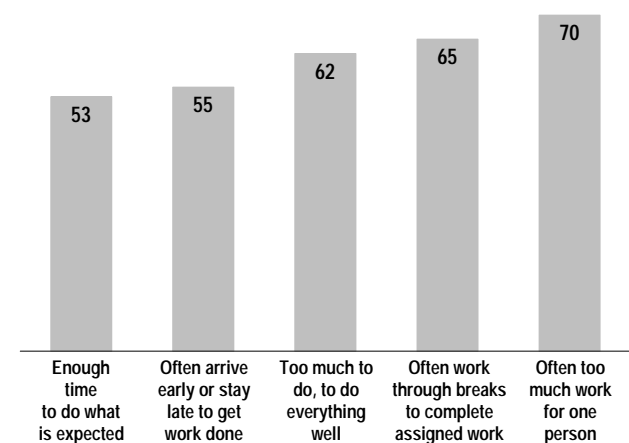
The majority of nurses felt overburdened by the amount of work they were assigned (Figure 2). Over two-thirds agreed with the statement, “It often seems like I have too much work for one person to

Figure 1
Percentage agreeing with items on Staffing and Resource Adequacy Subscale, registered nurses providing direct care to hospital patients, Canada, 2005



Source: 2005 National Survey of the Work and Health of Nurses.

Figure 2
Percentage agreeing with items on Role Overload Scale, registered nurses providing direct care to hospital patients, Canada, 2005



Source: 2005 National Survey of the Work and Health of Nurses.

do,” and 62% concurred with the statement, “I have too much to do, to do everything well.”

Nurses’ means of coping with their workload were assessed in the items, “I often have to work through my breaks to complete my assigned workload” (65% agreed), and “I often have to arrive early or stay late to get my work done” (55%). Somewhat surprisingly, though, over half (53%) agreed with the statement, “I am given enough time to do what is expected of me in my job.”

Hospital RNs reported that they were subject to work stress in varying degrees, depending on the stressor (Table 1). Nursing in Canada’s hospitals is highly unionized,²⁴ which likely accounts for the very high proportion (94%) who reported good job security. As expected, most (78%) hospital RNs reported their jobs to be quite physically demanding. Nearly three in ten (29%) did not agree that their supervisor was “helpful in getting the job done,” and an even higher percentage (46%) were classified as having low support from co-workers.

Correlates of medication error

Almost one-fifth (19%) of hospital RNs acknowledged that over the previous year, medication error involving patients who were in their care had occurred “occasionally” or “frequently” (Table 2).

Medication error was significantly related to overtime and shift length. Of nurses who usually worked overtime, 22% reported medication error, compared with 14% of those not working overtime. By contrast, among nurses who reported that they usually worked 12-hour shifts, the likelihood of medication error was slightly but significantly *lower* than for those who worked shorter shifts (18% versus 22%). For the other organizational factors studied—working more than 40 hours per week, full-time versus part-time employment, and usually working shifts other than days—no relationships with medication error were observed.

Medication error was related to nurses’ perceived “role overload.” In fact, the data suggested a gradient between the likelihood of error and the level of role overload (Table 2, Figure 3). Perceived adequacy of staffing and resources was similarly

Table 2
Percentage reporting occasional or frequent medication error in past year, by selected characteristics, registered nurses providing direct care to hospital patients, Canada, 2005

	%
Total	19.4
Work organization	
Overtime (main job)	
Does not usually work overtime [†]	13.7
Usually works overtime	21.8*
Hours per week (all jobs combined)	
Usually works 40 hours or more per week [†]	18.7
Usually works less than 40 hours per week	20.5
Number of jobs	
One [†]	20.0
More than one	16.3
Type of job	
Full-time [†]	20.2
Part-time	18.0
Shift usually worked	
Days	20.2
Other than days [†]	19.0
Length of shift	
Less than 12 hours [†]	21.7
12 hours	18.1*
Workplace environment	
Role Overload Index	
First quartile (lowest)	9.0
Second quartile	14.3 [‡]
Third quartile	22.1 [‡]
Fourth quartile (highest)	29.0 [‡]
Staffing and Resource Adequacy Subscale	
First quartile (most adequate)	9.2
Second quartile	13.5 [‡]
Third quartile	19.8 [‡]
Fourth quartile (least adequate)	31.6 [‡]
Nurse-Physician Working Relations Subscale	
First quartile (most favourable)	12.1
Second quartile	18.6 [‡]
Third quartile	20.2 [‡]
Fourth quartile (least favourable)	26.6 [‡]
Work stress	
Lower co-worker support	24.0*
Higher co-worker support [†]	15.3
Lower supervisor support	21.1
Higher supervisor support [†]	18.7
Lower job security	31.6*
Higher job security [†]	18.5
Higher physical demands	20.0
Lower physical demands [†]	16.8
Personal characteristics	
Job dissatisfaction	
Dissatisfied	27.9*
Not dissatisfied [†]	18.1
General health	
Good, very good or excellent [†]	19.2
Fair or poor	21.0
Mental health	
Good, very good or excellent [†]	18.9
Fair or poor	26.7
Nursing education	
Bachelor's degree or higher [†]	20.4
Other than bachelor's degree	19.1
Years of experience in nursing	
More than 5 [†]	19.8
5 or fewer	17.6

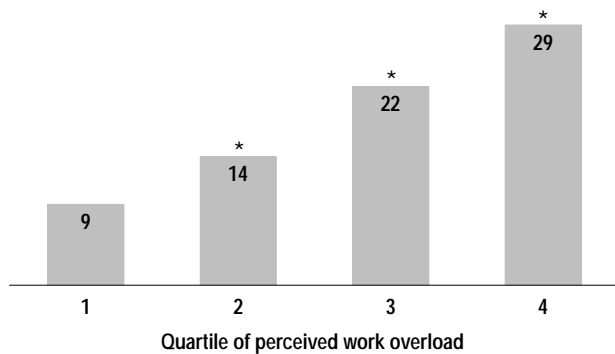
[†] reference category

* significantly different from estimate for reference category ($p < 0.05$)

[‡] significantly different from estimate for previous quartile ($p < 0.05$)

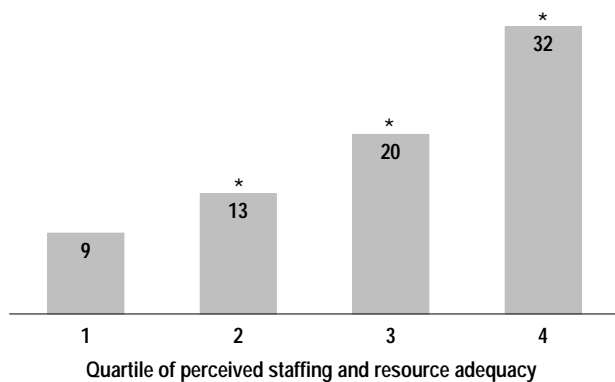
Source: 2005 National Survey of the Work and Health of Nurses.

Figure 3
Percentage reporting occasional or frequent medication error, by quartile of perceived work overload, registered nurses providing direct care to hospital patients, Canada, 2005



* significantly higher than estimate for previous quartile ($p < 0.05$)
Source: 2005 National Survey of the Work and Health of Nurses.

Figure 4
Percentage reporting occasional or frequent medication error, by quartile of perceived staffing and resource adequacy, registered nurses providing direct care to hospital patients, Canada, 2005



* significantly higher than estimate for previous quartile ($p < 0.05$)
Source: 2005 National Survey of the Work and Health of Nurses.

related to the likelihood of medication error (Figure 4).

The quality of working relations between nurses and physicians was also associated with medication error (Table 2). Only 12% of the RNs in the quartile in which working relations were most favourable reported medication error. This contrasted sharply with the value of 27% reported by those in the worst quartile of nurse-physician working relations.

Associations emerged between work stress and medication error. Nurses with low support from their co-workers were significantly more likely to report medication error, compared with those with more support. However, no significant association with supervisor support was observed. Low job security was significantly related to medication error: 32% of nurses with low job security reported medication error, compared with 19% of those with better job security.

The likelihood of medication error was not significantly related to level of nursing education, number of years as a nurse, or general health. The data suggested an association with mental health: 19% of hospital RNs who rated their mental health as “excellent,” “very good” or “good” reported medication error, compared with 27% of those with a rating of “fair” or “poor.” However, because of the small sample size for those in the “fair/poor” category, the difference fell short of statistical significance ($p=0.075$).

Multivariate analysis

Multivariate analysis was undertaken to examine associations of medication error with indicators of work organization and workplace environment, while controlling for the influences of the nurse’s personal characteristics. Of the work organization factors studied, the associations with medication error that were observed in bivariate analysis persisted for usually working overtime (positively related) and working 12-hour shifts (negatively related) (Table 3). Of the workplace environment factors examined, statistically significant associations with medication error persisted for adequacy of staffing and resources, role overload, nurse-physician working relations, job security, and co-worker support. As well, for staffing and resource adequacy, role overload and nurse-physician working relations, the suggested gradient in the relationship with medication error persisted.

Discussion

This study, based on a sample representative of all registered nurses providing direct care in Canadian hospitals, provides new information on nurses’ perceptions of medication error and factors

Table 3
Adjusted odds ratios relating selected characteristics to occasional or frequent medication error, registered nurses providing direct care to hospital patients, Canada, 2005

	Adjusted odds ratio	95% confidence interval
Overtime (main job)		
Does not usually work overtime [†]	1.0	...
Usually works overtime	1.4*	1.0 to 1.8
Hours per week (all jobs combined)		
Usually works 40 hours or more per week [†]	1.0	...
Usually works less than 40 hours per week	1.0	0.7 to 1.3
Number of jobs		
One [†]	1.0	...
More than one	0.9	0.6 to 1.2
Type of job		
Full-time [†]	1.1	0.9 to 1.5
Part-time	1.0	...
Shift usually worked		
Days	1.1	0.8 to 1.6
Other than days [†]	1.0	...
Length of shift		
Less than 12 hours [†]	1.0	...
12 hours	0.7*	0.5 to 0.9
Role Overload Index		
First quartile (lowest) [†]	1.0	...
Second quartile	1.3	0.8 to 2.1
Third quartile	1.7*	1.1 to 2.7
Fourth quartile (highest)	1.9*	1.2 to 3.0
Staffing and Resource Adequacy Subscale		
First quartile (most adequate) [†]	1.0	...
Second quartile	1.2	0.8 to 2.0
Third quartile	1.7*	1.1 to 2.7
Fourth quartile (least adequate)	2.7*	1.6 to 4.4
Nurse-Physician Working Relations Subscale		
First quartile (most favourable) [†]	1.0	...
Second quartile	1.5*	1.0 to 2.1
Third quartile	1.5*	1.1 to 2.1
Fourth quartile (least favourable)	1.6*	1.1 to 2.3
Work stress		
Lower co-worker support	1.4*	1.1 to 1.8
Higher co-worker support [†]	1.0	...
Lower supervisor support	0.9	0.7 to 1.1
Higher supervisor support [†]	1.0	...
Lower job security	1.7*	1.1 to 2.7
Higher job security [†]	1.0	...
Higher physical demands	1.1	0.8 to 1.5
Lower physical demands [†]	1.0	...
Job dissatisfaction		
Dissatisfied	1.0	0.7 to 1.5
Not dissatisfied [†]	1.0	...
General health		
Good, very good or excellent [†]	1.0	...
Fair or poor	0.7	0.4 to 1.2
Mental health		
Good, very good or excellent [†]	1.0	...
Fair or poor	1.3	0.8 to 2.3
Nursing education		
Bachelor's degree or higher [†]	1.1	0.9 to 1.5
Other than bachelor's degree	1.0	...
Years of experience in nursing		
More than 5 [†]	1.4*	1.0 to 1.9
5 or fewer	1.0	...

[†] reference category

* significantly different from estimate for reference category ($p < 0.05$)

... not applicable

Note: Based on data from 3,667 respondents. Variables for clinical area of usual employment and missing role overload were included in the model; their odds ratios are not shown.

Source: 2005 National Survey of the Work and Health of Nurses.

associated with it. Nearly one-fifth of nurses reported that patients in their care during the previous year had experienced medication error occasionally or frequently. The large size of the sample used for the analysis and the high response rate to the NSWHN enhance the strength of these findings.

Consistent with previous research,³³ usually working overtime was associated with medication error. This is an important finding, because working overtime is potentially remediable. Moreover, the potentially negative influence of overtime is not limited to medication error—a recent study of patient outcomes in an intensive care unit reported associations between overtime and a variety of adverse outcomes.³⁴

Although overtime was the only work organization variable positively related to medication error in this analysis, it is likely that workplace environment variables that were linked to medication error (perceived role overload and staffing/resource inadequacy) also stem from organizational characteristics.¹⁴ This suggests that “structure” and “process” variables interact. Similarly, low co-worker support, which was significantly related to medication error, could result from inadequate staffing. Nurses working at full capacity to care for their own patients may be less able or willing to lend a hand to co-workers. Poor job security was another work stress factor linked to medication error. However, its overall impact is less than that of other factors because of the small percentage of nurses affected.

While usually working overtime was related to increased odds of medication error, the odds of error in association with working 12-hour shifts were actually 30% lower than the odds for shorter shifts. This suggests that the distinction between scheduled and unscheduled time worked (time that is planned in advance versus time that is unanticipated) may be more important than the number of hours worked. The importance of the modestly protective association between 12-hour shifts and medication error is underscored by the fact that 45% of RNs providing direct care in Canadian hospitals work 12-hour shifts.

Why is this study important?

- Medication error is a potentially life-threatening, yet relatively common occurrence in hospitals.
- This study is based on the first nationally representative sample of Canadian hospital nurses, the people who typically administer medications to patients.

What else is known on this topic?

- Previous research suggests that work-related factors such as overtime, work stress and staffing inadequacy are linked to a variety of adverse patient care outcomes.

What does this study add?

- The National Survey of the Work and Health of Nurses provides information reported in confidence by nurses; such information is unavailable from any other source, including clinical records or administrative data.
- This study identifies numerous factors related to medication error in Canadian hospitals: usually working overtime, feeling overloaded, perceiving that staffing or resources are inadequate, poor nurse-physician relations, low co-worker support, and low job security.

Previous research on shift length has yielded mixed findings. Some studies have found shifts of 12.5 hours' duration to be associated with negative effects on various aspects of nursing performance.^{11,33,35} By contrast, others report improvements in nurse-patient communication, continuity of care and job satisfaction with the implementation of 12-hour shifts.^{23,36,37} Because these studies analysed a variety of performance indicators, and because sampling strategies and response rates differed markedly from those of the NSWHN, it is difficult to compare the NSWHN findings with those of other research to date.

The strong associations between medication error and perceived staffing and resource inadequacy and work overload corroborate those of other studies.^{5,13,14,38} Although methodological differences limit comparability, the overall consistency of findings is compelling.

An advantage of research based on the NSWHN rather than on administrative data is that for the survey, nurses would probably have been less reluctant to report the occurrence of medication error. As well, study of the correlates of medication error is enhanced by the array of information in the NSWHN about workplace conditions.

Limitations

Interpretation of the findings from the NSWHN is limited by the cross-sectional nature of the data. Because information was collected at one point in time, the temporal sequence between the dependent and independent variables cannot be established, and causality cannot be inferred. As well, both the dependent and independent variables were derived from nurses' self-reports, most of which were subjective. No validation of the data against objective sources was undertaken. The accuracy of reports of medication error, as well as independent variables such as the frequency of overtime, may have been influenced by recall bias. Such bias could also affect the observed strength of the association between variables—if, for example, the likelihood of reporting occasional or frequent medication error was correlated with that of reporting frequent overtime.¹⁹

Some factors that may have influenced the observed associations with medication error could not be taken into account because the requisite information was not available. For example, the professional staffing mix (the ratio of registered nurses to licensed practical nurses and auxiliary staff) has been shown to be associated with patient outcomes,¹² but could not be considered in this analysis. Similarly, no adjustment could be made for hospital size or administration system (for example, functional versus primary nursing).^{26,39} As well, information on patient characteristics that may have influenced the likelihood of medication error was not available.

Associations between variables may have been affected by differences in the reference periods of the independent variables and the dependent variable. Nurses were asked about the frequency of medication error over the past year, but all other variables used in this analysis referred to the time

of the interview. It is possible that nurses who had changed jobs within the year could have reported medication errors that had occurred in a setting to which their current job-related variables did not pertain.

Finally, small sample sizes precluded reporting of medication error by clinical area of employment.

Conclusion

In the view of many Canadian nurses, the restructuring of hospitals and downsizing of the nursing work force that has taken place since the early 1990s has had a major impact on the nursing work environment, and in turn, on the quality of

patient care.^{14,40-42} Findings from the NSWHN highlight relationships between risks to patient care and certain aspects of hospital nurses' work organization and the workplace environment. Usually working overtime, feeling overloaded, an environment where working relations between physicians and nurses are poor or where staffing and resources are inadequate, and lack of help from co-workers were all linked to medication error. It is hoped that this research will inform initiatives aimed at reducing risks to patient safety in Canadian hospitals. ■

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